Tribal ecoAmbassadors

College of Menominee Nation

Upgrade to Energy Efficient Appliances or Invest in Alternative Energy Sources?

AIHEC American Indian Higher Education Consortium

EPA United States Environmental Protection Agency

The College of Menominee Nation's (CMN) Tribal ecoAmbassador Program compared and contrasted energy investment strategies. Project participants conducted an array of experiments to determine whether it was more effective to upgrade to energy efficient appliances or invest in alternative energy sources.

Solar roof panels at College of Menominee Nation. *Photo courtesy of D. Kakkak, CMN.*

Dr. Lisa Bosman and project leaders developed four lab modules to give students hands-on experience in energy analysis techniques. Students in the first lab employed a Kill-A-Watt meter to measure the quantity of electricity that a given appliance uses. In the second lab, they used a web-application developed by the National Renewable Energy Laboratory to estimate the electricity generation of a grid-connected photovoltaic (PV) system. A third lab looked specifically at PV performance verification at CMN, while the final lab assessed PV technology at the Argonne National Laboratory.

Argonne National Laboratory gave project participants full access to its Midwest Photovoltaic Analysis Facility and associated performance data. Another project partner, the National Council for Science and the Environment, offered expertise and consulting services for enhancing performance outcomes.

The partnerships, along with project participants' research findings, have led to the development of an article that will be submitted to the Journal of Sustainability Education. Project participants concluded that investment in solar energy systems is efficient depending upon location and the cost of electricity. In sunny locations where there are higher amounts of solar irradiation, coupled with a higher cost of electricity, there will be a quicker return on solar investment. However, solar panels have a much lower energy value in locations with less annual solar irradiation and lower electricity costs, significantly affecting their overall return on investment.

The ecoAmbassadors project has facilitated curriculum development at CMN. The lab modules that were developed will be incorporated into courses offered through CMN's new Pre-Engineering Technology program. Additionally, the college benefited from polycrystalline and monocrystalline solar panels, which were installed on campus. A new website will allow students and faculty to monitor the panels for comparative data analysis on energy performance outcomes.

Cover: Solar panel installation. *Photo courtesy of D. Kakkak, CMN.*

Installation of solar panel. *Photo courtesy of D. Kakkak, CMN.*

The project has also had a great effect on student learning and our understanding of energy conservation. A post project energy literacy assessment indicated a 14-point increase in participating students' energy knowledge. Further, the lab modules developed for the project will be shared and disseminated to other educators. Dr. Bosman participated in the Environmental Protection Agency's Regional Tribal Operations Committee meeting in Chicago to discuss CMN's ecoAmbassadors project and to establish new partnerships.

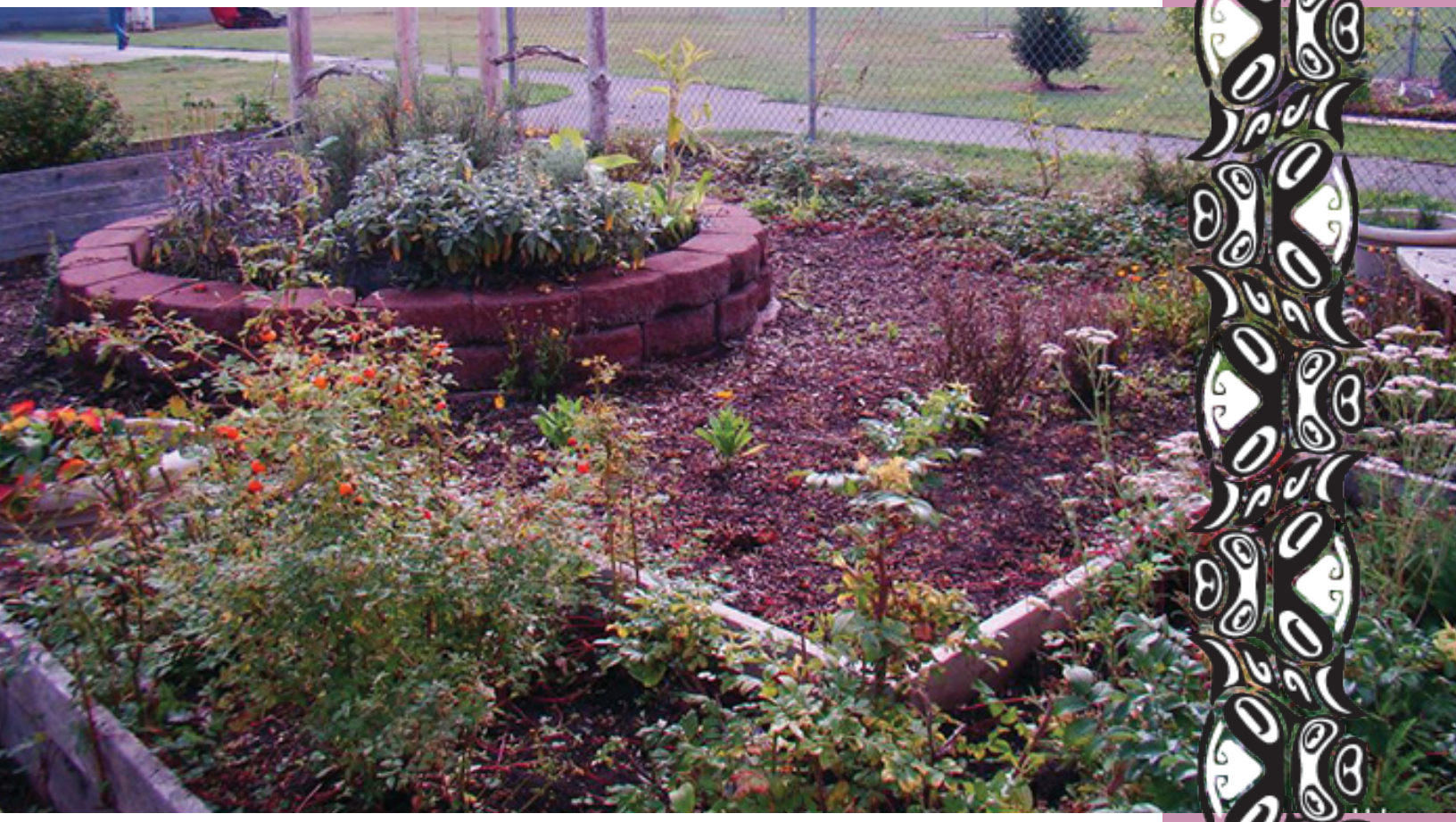
CMN's Tribal ecoAmbassador Program has given students tangible research experience in solar energy performance, meteorological monitoring, and in developing effective energy conservation strategies. The information, resources, and conclusions developed during this project will be used in future learning opportunities and will be disseminated to other academic institutions.

Securing infrastructure for solar panels. *Photos courtesy of D. Kakkak, CMN.*

Tribal ecoAmbassadors

Northwest Indian College

Utilizing Northwest Indian College Gardens for Native Plant Education



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The Northwest Indian College (NWIC) Tribal ecoAmbassador Program has focused on native plant education at the college and in the broader Lummi community. The initiative seeks to share traditional ecological knowledge of native plants and gardening techniques with project participants.

Many members of the Lummi community have lost their connection to traditional plants, and students today have not witnessed a traditional plant cycle. Fewer Lummi than ever know when, why, or how to harvest traditional plants. This project has helped educate the campus community, the local people, and visitors about the diverse plant life found on the NWIC campus and its surrounding environs. Through the cultivation and labeling of traditional plants, this ecoAmbassadors project has broadened knowledge of the flora that was used historically as medicine and food.

Led by ecoAmbassador coordinator La Belle Urbanec, project participants developed gardens on campus to provide learning opportunities for NWIC students. Lummi language speakers helped label native plants in Lummi, common names, and Latin. NWIC science students also used the gardens to expand their knowledge of plant ecology, water runoff, toxicology, soil composition, and growth rates.

Northwest Indian College Garden Project—The beginning. *Photos courtesy of La Belle Urbanic, NWIC.*

QR sign 'points' to the Northwest Indian College Plants and Garden website. *Photo courtesy of La Belle Urbanic, NWIC.*

Cover: Northwest Indian College Moon Garden. *Photo courtesy of La Belle Urbanic, NWIC.*

Project participants established five different gardens, each used for a unique purpose. The Sun Garden focused on edible plants. Students learned to distinguish between traditional and non-traditional vegetables, while also studying various horticultural methods. Although the garden remained dormant for most of the year to allow compost to breakdown, it has since flourished with a cornucopia of fruits and vegetables. The Sun Garden has provided NWIC students with hands-on experience in planting, mulching, and growing traditional plant foods.

Sun Garden—Materials that will be used to demonstrate mulching. *Photo courtesy of La Belle Urbanic, NWIC.*

Sun Garden—The blueberries planted along the fence show beautiful berries. *Photo courtesy of La Belle Urbanic, NWIC.*

Healing Garden—This is the center of the garden that was weeded in May by volunteers attending a gardening forum. Raspberry plants are on the right. *Photo courtesy of La Belle Urbanic, NWIC.*

The Healing Garden, alternatively, contains traditional plant foods, including non-tribal food plants, used for healing and good health. Students planted kale, berries, lettuce, and various tomato species among other food plants. The Healing Garden produced a healthy and bountiful crop that students proceeded to harvest in autumn.

Project coordinators took a different approach in devising the college's Salish Garden. A forest remnant of native plants that have thrived since NWIC's construction, the garden illuminates the nature of plant regeneration. The Salish Garden is located adjacent to the Salish Sea Research Center and has been used as an educational tool for native plant identification and ecology.

Salish Garden—The invasive Canadian Thistle (the purple flowered tall plants) has taken a prominent position within the garden and requires intensive and prompt removal. They will continue to be problematic for a few more seasons. *Photo courtesy of La Belle Urbanic, NWIC.*

Of the remaining two gardens, the Rain Garden was planted to control toxic runoff and filters storm water runoff from the college's parking lot with native plants.

Rain Garden—Rose Hips pictured above are used for medicinal tea. *Photo courtesy of La Belle Urbanic, NWIC.*

The Moon Garden, on the other hand, consists of healing plants from many cultures. The garden has bloomed with Echinacea, lavender, marigolds and local strawberries.

NWIC's ecoAmbassadors plant education project inspired teamwork and collaboration between departments, faculty, students, and the Lummi community to increase knowledge of native plants and growing techniques. Project partnerships with NWIC's Indigenous Service Learning office and the

Moon Garden—An excellent spot to enjoy lunch, sunshine, conversation, or for meditation, during those office and classroom breaks. *Photo courtesy of La Belle Urbanic, NWIC.*

Cooperative Extension office have blossomed into fruitful working relationships. Approximately 12 student interns and three faculty members assisted with garden maintenance and various project events, including a garden symposium that attracted a crowd of students, faculty members, and community participants.

Moon Garden—Both of these plants, purslane (Portulaca oleracea) and dandelions (Taraxacum officinale), are edible and grow at the entrance at the base of the arbor entryway. They are "volunteers." *Photo courtesy of La Belle Urbanic, NWIC.*

NWIC's Tribal ecoAmbassador Program taught participants how to cultivate their own food utilizing native plants and traditional practices that may, or may not, be adapted with current technology. The gardens have inspired students to take action in promoting plant sustainability, environmental protection, and native gardening.

Tribal ecoAmbassadors

Little Big Horn College

Health Impact of Sediment-Established *E. Coli* in Recreational Waters on the Little Big Horn River

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The ecoAmbassadors project at Little Big Horn College (LBHC) has worked to assess and quantify pathogens persisting in the stream bank sediments of the Little Big Horn River. Through the Tribal ecoAmbassador Program, LBHC has utilized EPA standards for *Escherichia coli* (*E. coli*) to measure the establishment and survival of *E.coli* populations

Tribal ecoAmbassador student intern testing samples. *Photo courtesy of LBHC.*

Cover: Little Big Horn College student conducting laboratory tests. *Photo courtesy of LBHC.*

in river bank sediments. The project also assesses the health impact that results from *E. coli* survival.

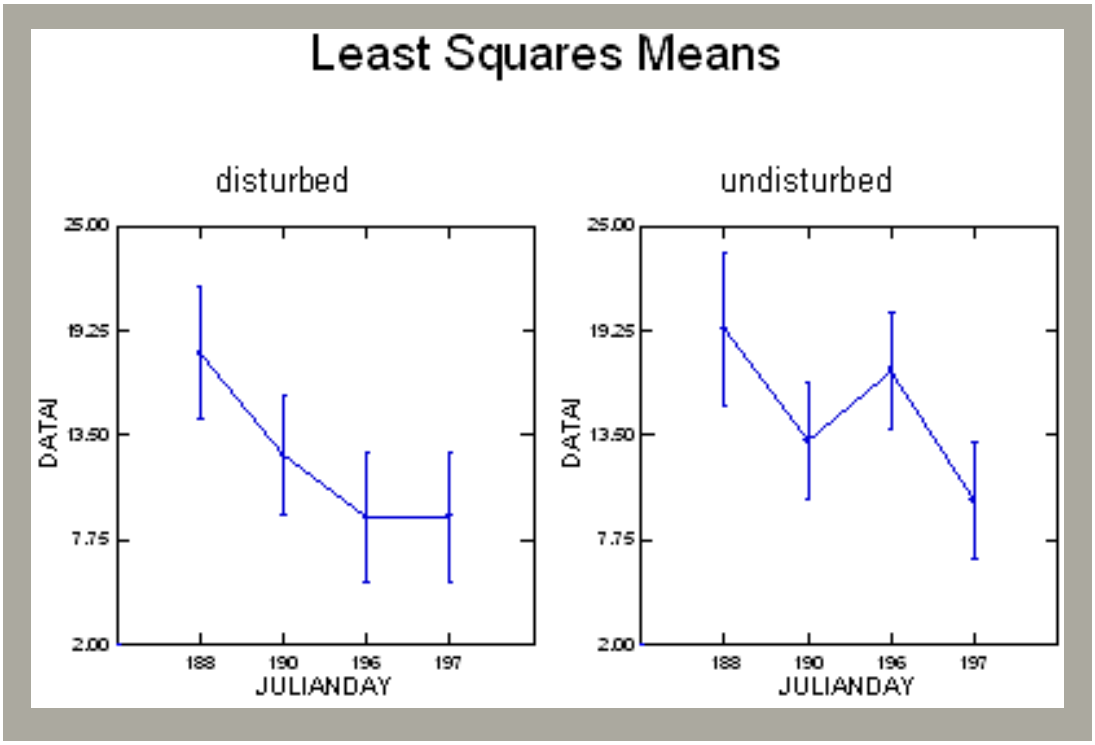
Portions of the Little Big Horn River near Crow Agency, Montana, are used for swimming annually in June, July, and August. During these months the flow of the Little Big Horn is slow enough that the sediment particles suspended in the water column are deposited on the bottom of the river. Such particles have been found to carry *E. coli.* During recreational use such as swimming, sediments are disturbed, creating an environment that puts swimmers at risk of exposure to the pathogens. The contamination of the Little Big Horn River with *E. coli* is a significant health concern for the people who utilize its waters for both drinking and recreation.

Led by project coordinator Sara Plaggemeyer, LBHC's Tribal ecoAmbassador Program has collected and analyzed water samples to test for *E. coli* in the river. The project has provided over 30 LBHC students with hands-on field experience in water quality sample collection, microbial laboratory analysis, and environmental research.

The project team collected core samples from different areas along the Little Big Horn River. Researchers collected water samples before and after sediment had been disturbed, helping them identify where the pathogens may exist. The team also identified water parameters, including temperature, conductivity, turbidity, levels of pH, and dissolved oxygen.

Researchers collected water sample sets in the spring and summer of 2014. The research team compared previously collected *E. coli* isolates from the same site with current *E. coli* populations. Researchers examined the samples at the LBHC laboratory.

When analyzed statistically, the data demonstrated that *E. coli* colonies were more abundant in the undisturbed samples than in the disturbed samples. Statistical analysis suggested that as sediment increased, the number of bacteria decreased. Over the entire period of study there was an increase of 2.8 colonies in the undisturbed samples (see table below).



Comparison of analyzed data from disturbed and undisturbed water samples.

The results of the LBHC ecoAmbassadors study were specific to the identified site alone. The results of this study indicate that disturbing sediment during recreational swimming may not be a health issue. However, due to the threat that *E. coli* poses to public health, further research is warranted.

Tribal ecoAmbassador student interns collecting water samples on the Little Big Horn River. *Photos courtesy of LBHC.*

Tribal ecoAmbassadors

Tohono O'odham Community College

Creating a Carbon-Negative Building Material from Recycled Glass, Steel Dust, and Carbon Dioxide

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Tohono O'odham Community College's (TOCC) Tribal ecoAmbassador Program recently completed its third project year. The TOCC project led to the development of a sustainable building material consisting of local recycled glass, waste steel dust waste and carbon dioxide. The material has been used to make highly durable building blocks and can be poured to construct sidewalks, floors, ramps, and even artworks. The product is called "ferrock," as iron (Fe), which is an ecologically preferable material to concrete, is a key component in the mixture.

TOCC's multi-faceted project supports the local recycling of glass bottles on the Tohono O'odham reservation. Bottles are pulverized and separated into fine and coarse cullet, both of which are used as aggregate to make pre-cast building products and larger structures. The glass particles are bound together by an iron carbonate mineral matrix rather than Portland cement. Steel dust is the solid waste material that is used to bind the glass particles. In the presence of water, it reacts with carbon dioxide and is then trapped in the carbonate mineral. The process therefore is "carbon negative" unlike Portland cement, which is a significant source of CO2 during manufacture.

Led by Dr. David Stone and Dr. Casey Kahn-Thornburg, the project has improved the quality in brick, sidewalk, floor, and artwork production. More recently, project coordinators have created pavers for the Tohono O'odham Museum and Culture Center's

Materials combined to create building material including pulverized glass and steel dust waste. *Photo courtesy of TOCC.*

Cover: Production of building blocks made from recycled glass, steel dust and CO2. *Photo courtesy of TOCC.*

patio. Weighing approximately 250 pounds apiece, all of the patio pavers were made, moved, and placed by hand. For this project alone, more than 50,000 glass bottles, and several tons of steel dust have been recycled, and a significant amount of CO2 has been trapped.

Large paver molds used to create pavers for TOCC Cultural Center patio. *Photo courtesy of TOCC.*

Tribal ecoAmbassador student intern working with building material. *Photo courtesy of TOCC.*

Researchers who have worked on the ecoAmbassadors project continue to publish their findings on how recycled materials can be used to create products for building construction. The TOCC Tribal ecoAmbassador Program has built connections with Arizona State University to further research this new technology in creating sustainable building materials. TOCC is also collaborating with the University of Arizona to explore the development of other self-sustaining economic ventures.

TOCC's ecoAmbassadors project has helped forge numerous community partnerships. Collaboration with Tohono O'odham Solid Waste Management has led to cleanup trips and new recycling awareness efforts in the tribal community. TOCC's ecoAmbassadors has also partnered with the Tohono O'odham Environmental Protection Office to improve awareness of environmental issues facing the Tohono O'odham Nation and to establish volunteer opportunities.

Tribal ecoAmbassador student intern setting building material into paver molds. *Photo courtesy of TOCC.*

The ecoAmbassadors project supports tribal college students as well. At TOCC approximately nine student interns have gained hands-on experience through glass clean-up efforts, pulverizing glass, creating the building material, and setting

the material into various molds. TOCC continues to explore the possibility of launching a business version of ecoAmbassadors.

The TOCC Tribal ecoAmbassador Program is a collaborative effort that encourages synergistic networking for the mutual benefit of all project partners. With ecoAmbassadors, TOCC has successfully transformed what is often viewed as a mundane chore—recycling—into an inspiring and culturally meaningful activity.

Tribal ecoAmbassador student interns transporting hardened pavers. *Photo courtesy of TOCC.*

Setting pavers to be used for the new patio at the TOCC Cultural Center. *Photo courtesy of TOCC.*